

## Unit 10 – The Cardiovascular System

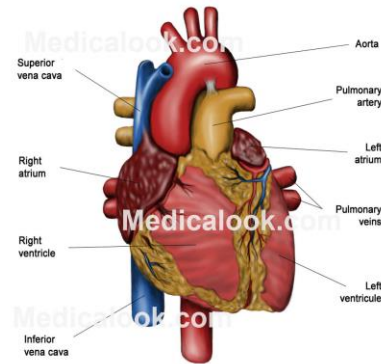
Pleasant Valley High School  
Anatomy and Physiology

### 13.1 Introduction

- Made of 3 parts
  - The heart, tissues, cells
- Supplies
  - Fuel for the body (sugars)
  - Oxygen...Oxygen...Oxygen
- Gets rid of CO<sub>2</sub> waste

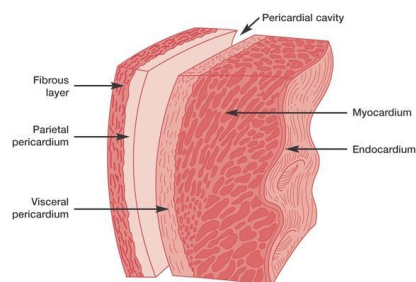
## 13.2 Structure of the Heart

- Pericardium –
  - Fibrous outer sac around the heart
  - Visceral pericardium (epicardium)
  - Parietal epicardium (inner lining)
  - Attached to the diaphragm
- Pericardial Cavity –
  - Contains serous fluid



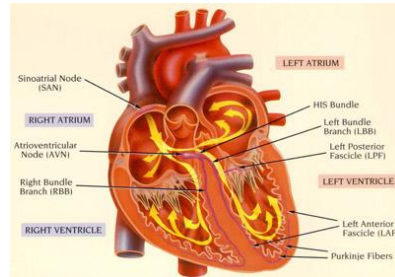
## The Heart Wall

- Epicardium – protects the heart by reducing friction
- Myocardium – mostly cardiac muscle
- Endocardium – epithelium and CT with elastic and collagenous fibers
  - Blood vessels and *Purkinje fibers* (cardiac muscle fibers)



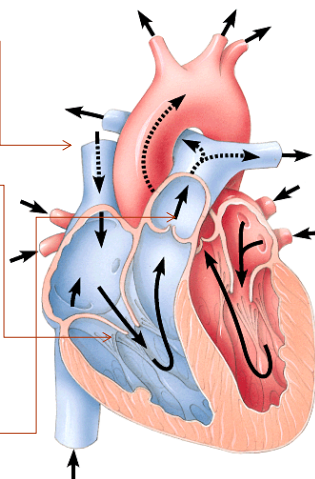
## Chambers and Valves

- Right Side
  - Atria and ventricle, tricuspid valve, papillary muscles provide attachment point for *Chordae tendineae* (heart strings)
- Interventricular Septum – separates right and left side
- Left Side
  - Atria and ventricle, bicuspid valve (mitral valve)

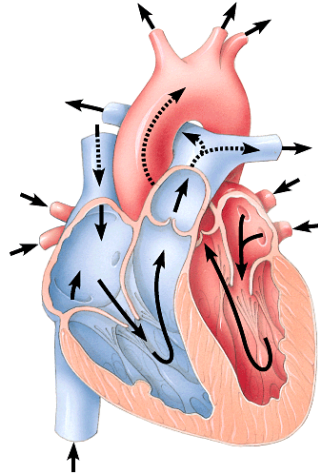


## Veins and Arteries

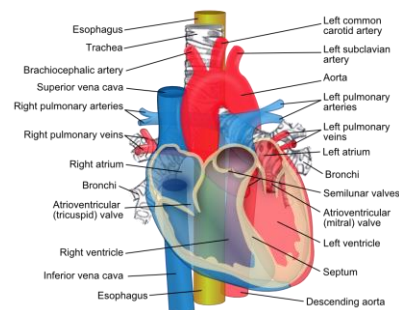
- Superior and Inferior Vena Cava – bring deoxygenated blood into the RA
- Blood goes through the tricuspid into the RV
- Through the pulmonary semilunar valve into the pulmonary arteries (only arteries that carry deoxygenated blood) and into the lungs



- Oxygenated Blood returns to the heart through the right and left pulmonary veins (only veins that carry oxygenated blood)
- They empty into the left atrium. Blood passes through the bicuspid valve and into the LV
- Oxygenated blood leaves the heart through the Aortic semilunar valve into the Aorta and is delivered to the body below the heart



- The Aorta
  - Three branches that deliver blood superior to the heart
    - Brachiocephalic Artery
    - Common Carotid Artery
    - Left Subclavian Artery



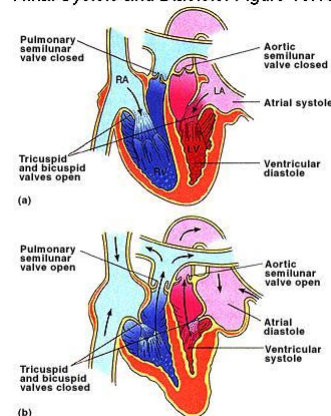
## Blood Supply to the Heart

- The first two branches of the aorta (right and left coronary arteries) supply blood to the heart tissues
- Coronary veins retrace the path of the arteries and empty de-oxygenated blood into the coronary sinus and then back into the right atrium.
- The body tissues require constant blood flow, thus a fresh supply of oxygenated blood is required for survival
- The Coronary sinus is an enlarged vein on the posterior of the heart

## 13.3 Heart Actions

- Systole – atria contract and ventricles relax
- Diastole – ventricles contract while the atria relax
- The combination of systole action followed by one diastole action constitutes ONE *cardiac cycle*

Atrial Systole and Diastole. Figure 15.16



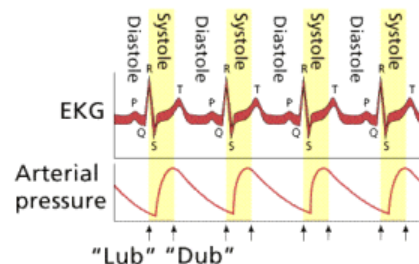
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## Cardiac Cycle

- Early diastole – ventricle pressure is low, atrial pressure is high. This difference causes the valves to open and allow blood to enter the ventricles
- As ventricles contract, pressure in them rises and exceeds atrial pressure thus causing the valves to close
- When the ventricles contract, atria are relaxed and pressure is low.
- When ventricular pressure exceeds atrial pressure, the semi-lunar valves open and allow flow into the arteries
- Pressure drops in the ventricles until it is below that of the atrium, then the semi-lunar valves close. The ventricles then fill again...a vicious cycle

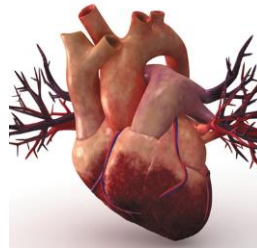
## Heart Sounds

- *Lubb – Dupp* -
  - Lubb is when the ventricle contracts and AV valves are closing
  - Dupp is when ventricles relax and pulmonary and aortic valves are closing



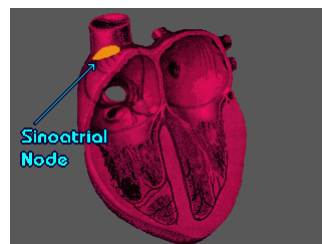
## Cardiac Muscle Fibers

- Function much like skeletal fibers, but are connected in branching networks
- *Functional syncytium* - a mass of merging cells that function as a unit
  - *Two structures in the heart*
    - *Atrial syncytium*
    - *Ventricular syncytium*

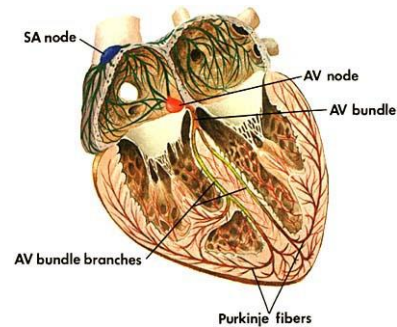


## Cardiac Conduction System

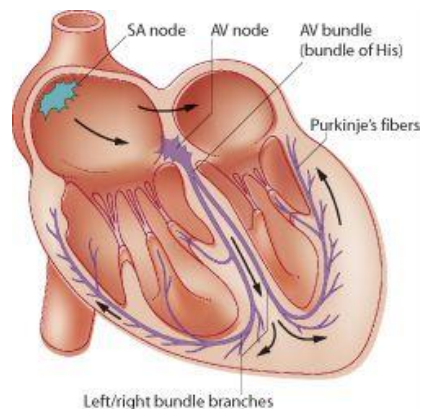
- Instead of contracting, some areas of the heart are responsible for the electrical conductivity of the heart
- Sinoatrial node – small mass of cardiac tissue just below the epicardium near the top of the RA, it is known as the “pacemaker” for the heart because it generates the heart’s rhythmic contractions



- Impulse travels from the SA node to the atrial syncytium and the atria contract at the same time
- Impulse travels to a mass of tissue called the *atrioventricular node* in the inferior portion of the septum that separates the atria



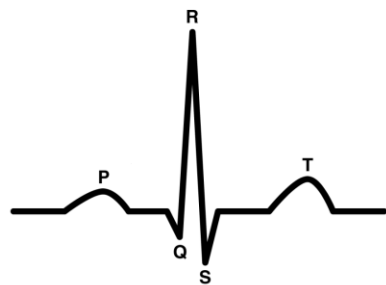
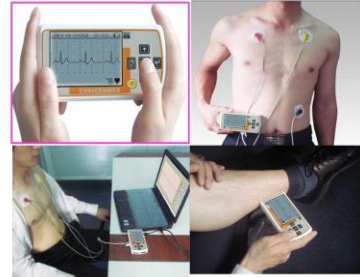
- From the AV node, the impulses pass to the AV bundle (*bundle of His*). It then enters the upper part of the interventricular septum and divides into R & L branches. This gives rise to the Purkinje fibers
- These fibers project into the papillary muscles. They branch off and become continuous with many muscle fibers





## Electrocardiogram (ECG)

- A recording of the electrical changes that occur in the myocardium during the cardiac cycle
- Electrodes are placed on the skin and pick up weak electrical charges and transfers those charges to paper.

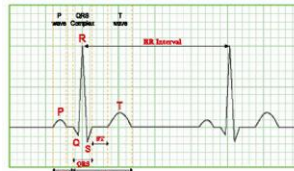


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- P wave – atrial fibers depolarize, atria contract
- Q, R, S Waves – depolarization of ventricular fiber and contraction of ventricles, QRS Complex
- T Wave – ventricles re-polarize, Atrial fibers are lost in this wave because the repolarize at the same time.

## Some Abnormal ECGs

A Normal ECG Waveform



Some Examples

Normal Rhythm



Atrial Fibrillation



Premature Ventricular Contraction

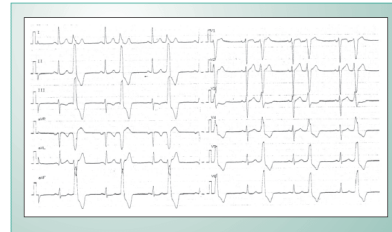


Fig. 1 - Example of RVO1 PB

## Regulation of the Cardiac Cycle

- Sympathetic and parasympathetic fibers send motor impulses to the SA node to increase or decrease heart rate
- Acetylcholine – decrease heart rate
- Norepinephrine – increase heart rate
- Medulla Oblongata is the cardiac control center
- Rising temperature causes heart rate to increase, low body temp decreases heart rate
- K and Ca increase heart rate, low concentration reduces it

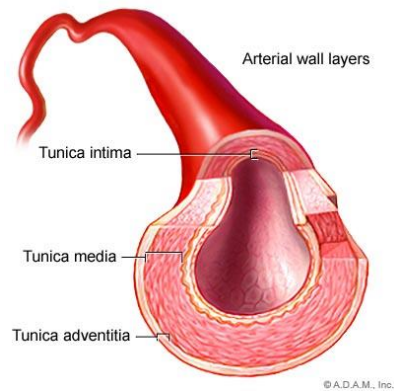
## Blood Vessels

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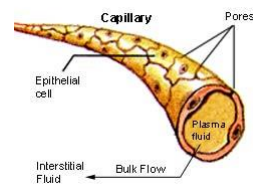
### 13.4 Blood Vessels

- A closed circuit of tubes that carry blood from heart to cells and back again
- Include: arteries, arterioles, capillaries, venules and veins
- In one human adult, there are over 62,000 miles of blood vessels...2.5 times the diameter of the earth.

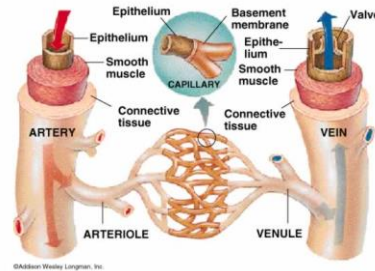
- Arteries – strong elasticity, carry high pressure blood
- Arterioles – fine branches from arteries
- 3 layers of arterial walls
  - Tunica intima
  - Tunica media
  - Tunica externa
- Vasoconstriction
- Vasodilation



- Capillaries – semipermeable, read pg. 343
- Capillary exchanges: diffusion, filtration, osmosis
- Colloid Osmotic Pressure – osmotic effect due to plasma proteins in capillaries

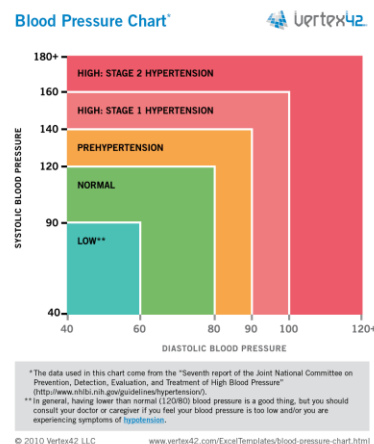


- Veins and Venules
  - Venules are microscopic vessels that continue from capillaries and merge to form veins
  - Carry de-oxy blood back to the atria
  - Contain valves that help push blood
  - Function as blood reservoirs...if there is a drop in atrial pressure, the veins hold blood and keep flow normal.



## 13.5 Blood Pressure

- Refers to pressure in arteries
- Systolic Pressure – max pressure during ventricular contraction
- Diastolic Pressure – lowest pressure that remains in the arteries before ventricular contraction

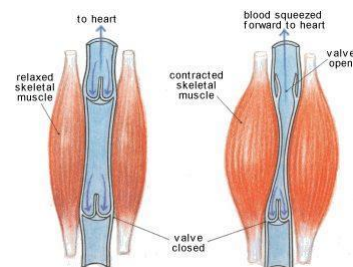


## Factors on BP

- Heart Action
  - Stroke volume – amt of blood that leaves the LV per contraction
  - Cardiac output – amt discharged from the LV per minute
- Blood Volume
  - Approx 5 liters for adults
- Peripheral Resistance
  - Friction between blood and walls of veins and arteries
- Blood Viscosity
  - Ease in which molecules move past one another

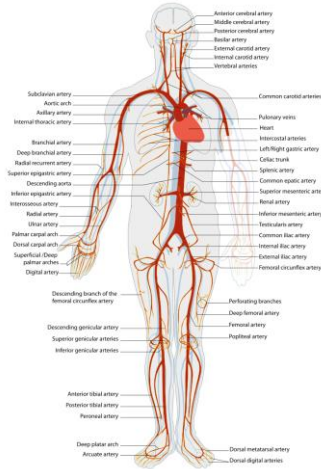
## Venous Blood Flow

- Read article on Pg. 350
- Depends on skeletal muscle tone
- Venoconstriction – veins constrict and force blood into the heart
- Pulmonary Circuit – right side of heart
- Systemic circuit – left side of the heart



## 13.7 The Arterial System

- Aorta –
  - Largest artery in the body
- Branches –
  - brachiocephalic, common carotid, subclavian
    - Common carotid takes blood to the brain
- Celiac, superior vena cava, inferior vena cava, mesenteric, suprarenal, renal, gonadal, common iliac



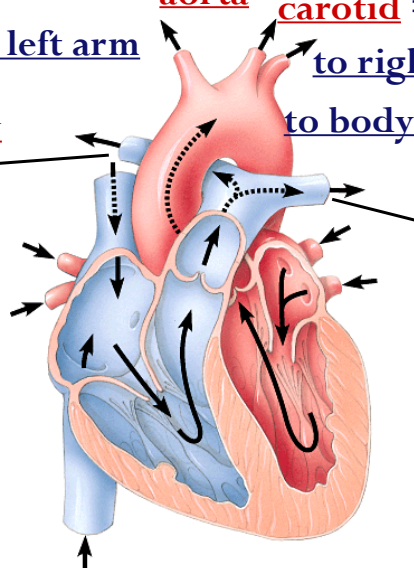
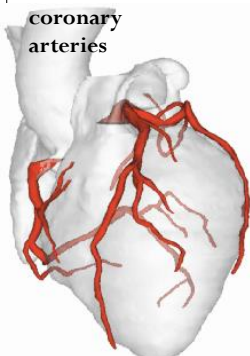
### Major arteries

aorta carotid = to head  
to brain & left arm to right arm

pulmonary artery

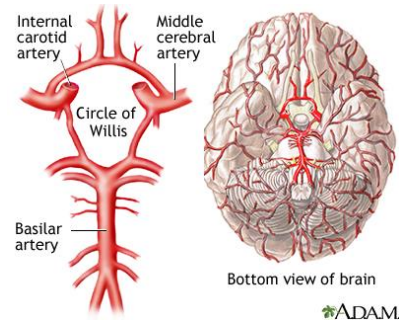
to body

pulmonary artery = to lungs



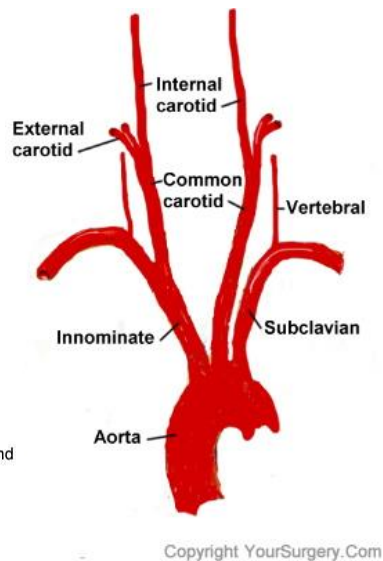
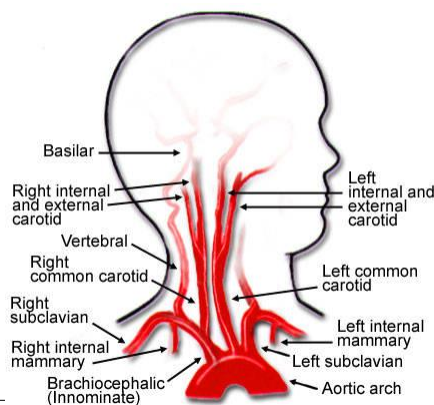
## Arteries of the Neck, Head, and Brain

- Vertebral Arteries – pass through the foramen magnum
- Basilar Artery – formed by united vertebral arteries, supplies the pons, midbrain and cerebellum
- Posterior cerebral arteries are formed by dividing the basilar artery into 2 branches
  - These arteries form the circle of Willis



## Continued...

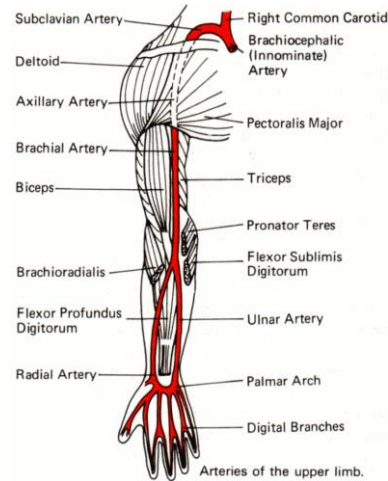
- Thyrocervical Arteries
- Internal and External Carotid Arteries





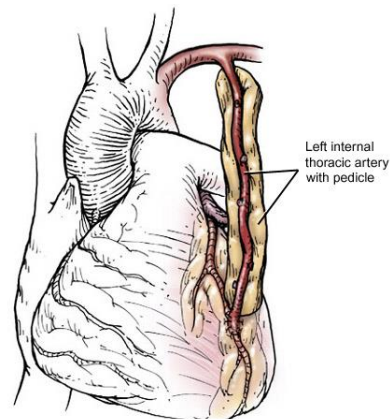
## Arteries of the Upper Limb

- Axillary Artery – supplies to the chest and turns into the...
- Brachial artery – follows the humerus to the elbow, then divides into
  - Ulnar Artery
  - Radial Artery



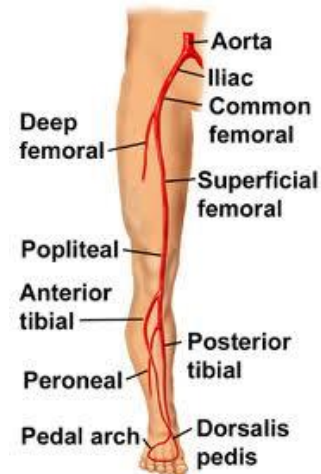
## Arteries of the Thoracic and Abdominal

- Internal thoracic branches off the subclavian artery



## Arteries to the Pelvis and Lower Limb

- Abdominal aorta divides into the common iliac arteries
- Internal Iliac branches off to pelvic muscles, visceral organs, gluteal muscles, and external reproductive organs
- External Iliac provides blood to the lower limbs
- Femoral artery branches into the thigh
- Popliteal Artery forms behind the knee from Femoral
- Tibial Arteries lowest limb structures and feet



## 13.8 Venous System

- Head, Neck, Upper Limb, and Shoulder
  - Jugular (internal and external)
  - Brachiocephalic
  - Basilic
  - Cephalic
- Abdominal and Thoracic Wall
  - Azygous
  - Hepatic Portal

- Lower Limbs and Pelvis
  - Popliteal
  - Femoral
  - External Iliac
  - Great and Small Saphenous
  - Internal Iliac
  - Common Iliac